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(19)

(54) DYNAMO ELECTRIC MACHINES

(71) We, LUCAS INDUSTRIES LIMITED, formerly Joseph Lucas (Industries) Ltd., a British Company, of Great King Street, Birmingham B19 2XF, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to dynamo-electric machines and has for its object to provide such a machine in a simple and convenient form.

According to the invention a dynamo-electric machine comprises in combination, a casing, a rotor structure carried on a shaft rotatably mounted in the casing, a stator structure within the casing, said rotor and stator structures including windings, passage means in said shaft, a coolant pump driven from said shaft, said coolant pump having an outlet communicating with said passage means, apertures opening on the periphery of said shaft, said apertures communicating with said passage means whereby during rotation of the shaft coolant will be directed onto the windings of the stator and rotor assemblies to effect cooling thereof, a sump for the coolant and into which the coolant flows after contact with the windings and a heat exchanger in the sump whereby heat exchange can be effected between the coolant in the sump and a fluid supplied to the machine from an exterior source.

One example of a dynamo electric machine in accordance with the invention will now be described with reference to the accompanying drawing which is a sectional side elevation through an alternator.

With reference to the drawings, the alternator comprises a generally annular casing 10 having end closure members 11 and 12. The end closure members carry bearings 13 of a rotary shaft 14 driven by any convenient means.

Mounted within the casing 10 are a pair of stator structures 15 which carry output windings 16 connected so as to provide a pair of three phase electrical supplies. The output windings are connected to terminals 17 mounted on a terminal block carried on the exterior of the housing 10. The output windings are identical and two three phase supplies may be obtained from the alternator, or alternatively the windings can be connected in parallel to obtain a single three phase supply.

Associated with the stator structures 15 are a pair of rotor structures 18 respectively, and these are mounted on the shaft 14 so as to rotate therewith. Each rotor sturcture is of cruciform configuration and carries exciting windings 19 around each of the four poles defined by each rotor structure.

Also mounted on the rotor shaft is a yoke 20 which carries the output winding 21 of an exciter 22. The output winding 21 produces an alternating current output and this is rectified by means of rectifiers 23 mounted on a carrier forming part of the yoke 20. The direct current output produced by the rectifiers is supplied directly to the windings 19 of the rotor structures 18.

The exciter 22 has an input winding 24 which is supplied with current from an external source. The magnitude of the current flow can be controlled in order to control the output of the alternator.

In order to provide for cooling of the windings of the stator and rotor structures, the shaft 14 is provided with a blind bore 25 and the shaft is drilled at positions therealong to define apertures 26 through which coolant supplied to the bore 25 is directed at the windings of the rotors and stators. The coolant is supplied to the bore 25 by means of a pump, as shown a gear pump 27, carried by a mounting member 28 which is secured to the closure member 11. The gear pump includes a drive shaft 29 which is coupled by means of gearing 30 to the shaft 14, and the outlet of the gear pump is in communication with the bore 25. The inlet 31*a* of the gear pump is connected by an exterior pipe 31 to a sump 32 which is secured to the lowermost portion of the casing 10. In this region the casing is provided with a series of apertures and the

sump also incorporates a baffle plate 33 which is also apertured to allow the coolant. after it has passed over the windings, to return to the sump.

The sump also incorporates a heat exchanger which is in the form of a sinuous tube 34 having an inlet and an outlet on the exterior of the sump. The arrangement is such that fluid can be passed through the tube 34 from an external source, so that a heat exchange is achieved between the coolant and the fluid. Conveniently the fluid is water and whilst in most cases this will be cool water it may in certain circumstances be warm water in order to provide for heating of the coolant within the alternator when the latter is started. Conveniently the coolant is oil which also serves to lubricate the bearings 13. In extreme conditions the oil may become very cold hence the need to provide for warming of the oil when the alternator is first started; and in addition, in order to prevent an excessively high pressure developing at the outlet of the gear pump, a pressure relief valve not shown may be provided. The relief valve will discharge the coolant back to the inlet of the gear pump.

In addition, a pressure sensitive switch may be provided in the outlet of the gear pump and which is associated with electrical control equipment to ensure that the alternator does not supply electrical power until a pressure exists at the outlet of the gear pump. Furthermore, there may be located in the sump a temperature sensitive switch which is responsive to the oil temperature, the switch being associated with the electrical control equipment to ensure that no power is supplied by the alternator until the temperature of the oil is sufficiently high to allow proper circulation thereof.

The electrical control equipment may be housed in the sump at a position adjacent the tube 34 so as to maintain its temperature substantially constant. The control equipment varies the current flowing in the input winding 24 to control the output of the alternator. The control equipment derives power from a separate winding which is wound in the same slots in one of the stators 15 as is the associated output winding; moreover, the pitch of the winding may be different to minimise magnetic interaction. The control equipment senses the output voltage and current in the stator output windings and varies the current flowing in the input winding 24.

WHAT WE CLAIM IS:—

1. A dynamo electric machine comprising in combination a casing, a rotor structure carried on a shaft rotatably mounted in the casing, a stator structure within the casing, said rotor and stator structures including windings, passage means in said shaft, a coolant pump driven from said shaft, said coolant pump having an outlet communicating with said passage means, apertures opening on the periphery of said shaft, said apertures communicating with said passage means whereby during rotation of the shaft coolant will be directed onto the windings of the stator and rotor assemblies to effect cooling thereof, a sump for the coolant and into which the coolant flows after contact with the windings and a heat exchanger in the sump whereby heat exchange can be effected between the coolant in the sump and a fluid supplied to the machine from an exterior source.

2. A machine as claimed in claim 1 including, a pressure relief valve whereby coolant may flow back to the inlet of the pump from the outlet thereof, to prevent an excessively high pressure developing at the outlet of the pump.

3. A machine as claimed in claim 2 in which pressure sensitive means is provided in the outlet of the pump to ensure that the machine does not supply power until coolant pressure exists at the outlet of the pump.

4. A machine as claimed in claim 1 in which the heat exchanger comprises a tube located in the sump, the tube having an inlet and outlet on the exterior of the sump.

5. A machine as claimed in claim 1 or claim 4 in which the machine is an alternator and includes electrical control equipment for controlling the electrical output of the alternator, said control equipment including a temperature responsive switch located within the sump, said switch being associated with the control equipment and arranged so that no power is supplied by the alternator until the coolant temperature is sufficiently high to ensure proper circulation thereof.

6. A machine as claimed in claim 5, in which the control equipment is located within the sump.

7. A dynamo electric machine substantially as hereinbefore described with reference to the acccompanying drawing.

MARKS AND CLERK.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*